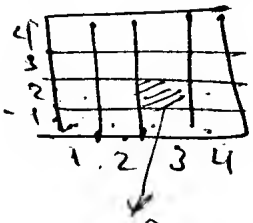
Sampling & quantization

$f(x,y)$ = Image

Sampling : the process of digitizing the spatial coordinates (x,y)



Quantization : the process of digitizing the amplitude (e.g. intensity level) values.

0 1 2 3 4 ... 255

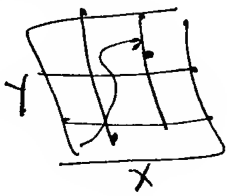
Image Representation

- Surface (3-D image)

  image where two dimension represent spatial coordinates (x,y) and the third dimension is the intensity level.

- Image for human

  2-D image



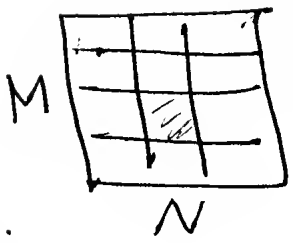
  used by human to see objects.

- Array images (used in algorithms)

  the image is represented as matrix of f values

k-bit image

bit k لكل pixel



$L = 2^k$: no. of intensity levels.

مثلا e.g 8-bit ⇒ 256 Level

Dynamic Range = $\frac{\text{Max intensity Level}}{\text{Min intensity Level}}$ في الصورة

Contrast = Max intensity Level − Min intensity Level

ممكن حسب لوضوح الصورة

Max intensity is Controlled by Saturation تشبع

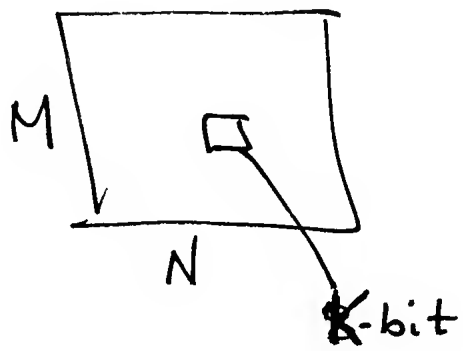
Min intensity Level is Controlled by noise

Image Storage

$b = M \times N \times K$

b: Storage of image by bits

K: no. of bits for each pixel



atial resolution no. of pixels per unit distance. (DPI)

intensity resolution: no. of bits used to quantize intensity.

no. intensity = 2^K

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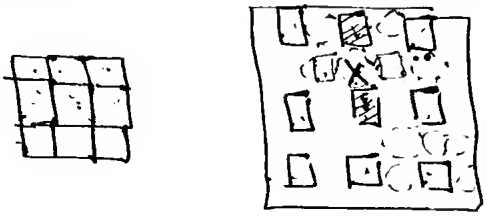
interpolation: is the process of using Known data to estimate values of unknown Locations.

Resizing تغيير حجم الصور



Types of interpolation:

① nearest neighbor interpolation

it assigns to each new Location the intensity of its nearest neighbor in the orginal image.

(Produce Bad results (Pixeled images))

② bilinear :

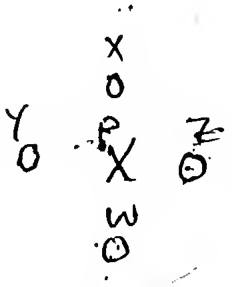
Use the 4 nearest neighbors to estimate the intensity at agiven Location

(give better results)

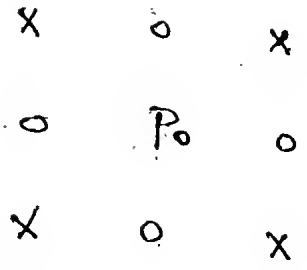
③ bicubic which involves the 16 nearest neighbor of a point.

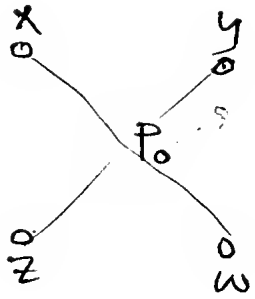
(Best results)

neighborhood & adjacency



الجار الرابع $= N_4(p) = \{x, y, z, w\}$



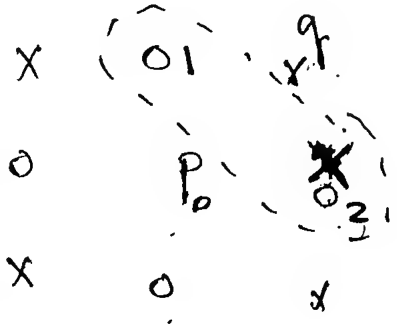


الجار القطري $N_D(p) = \{x, y, z, w\}$

Diagonal قطر

$N_8(p) = N_4(p) \cup N_D(p)$

الجار الثماني



$V = \{5, 6, 10\}$

↓

List of intensity

$N_m(p) \Rightarrow N_4(p) \Rightarrow x \in N_m(p)$

or $\hookrightarrow N_D(p)$ iff $N_4(p) \cap N_4(q) = \phi$

Sensors to Capture Images

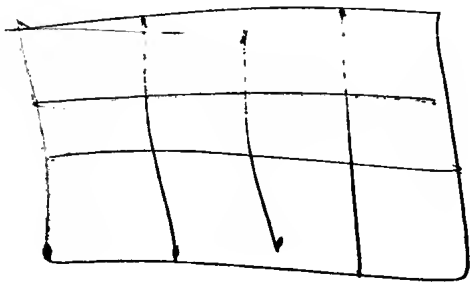
1 Single sensor

both x & y dimension are controlled by Mechanical movement.

2 Sensor Strip

- one dimension is controlled by mechanical Movement
- the other direction is controlled by the no. of sensors on the strip.

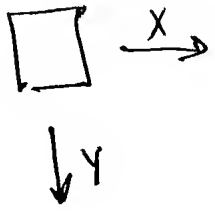
3 Sensor Array



- no mechanical Movement

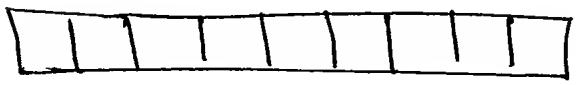
Image Acquisition

1 Single Sensor



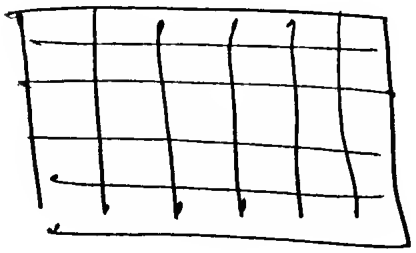
both x & y dimension is controlled by mechanical movement.

2 Sensor Strip



- one dimension is controlled by the number of sensors
- and the other dimension is controlled by mechanical movement.

3 Array Sensor



- No mechanical Movement
- two dimensions of image are controlled by number of pixels in the 2-D array.